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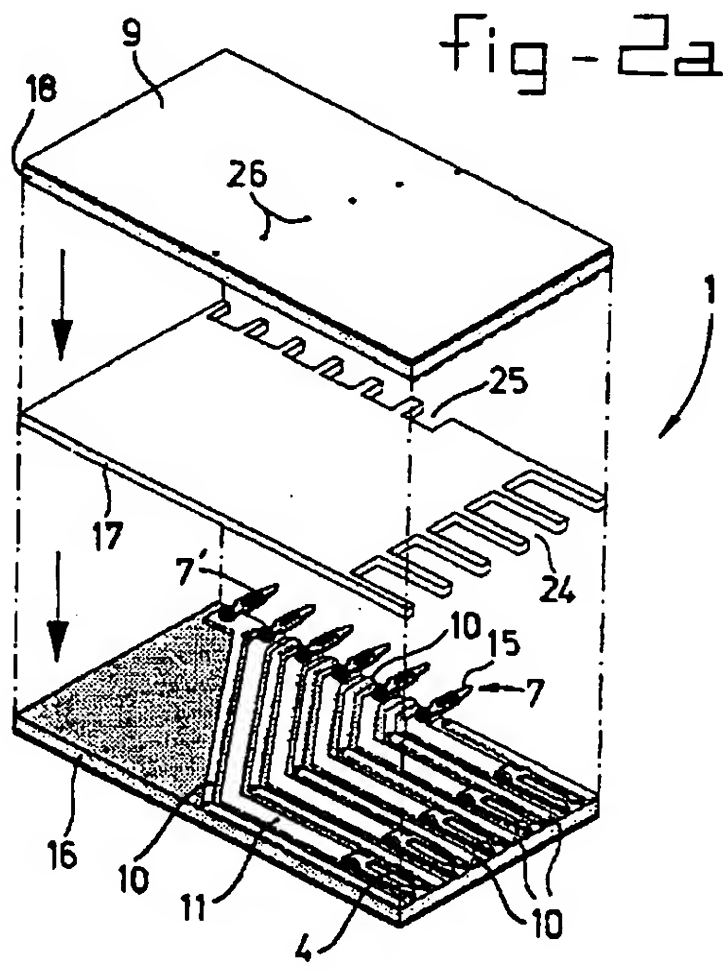
(54) Connector, preferably a right angle connector, with integrated pcb assembly

(57) A connector, preferably a right angle connector, comprising one or more integrated pcb assemblies (1), each of said pcb assemblies comprising an insulating substrate (16), a spacer (17) and a cover plate (18), each of said insulating substrates (16) comprising a predetermined pattern of conducting tracks (11) on a first surface, each of said conducting tracks (11) having one end for connection to one first contact terminal (4) for mating contact with a mating contact terminal of a mating connector, and another end for connection to one second contact terminal (7) wherein each of the spacers (17) are provided with a first set of one or more first openings (24) each arranged for accommodating at least part of one first contact terminal (4) and with a second set of one or more second openings (25) each arranged for accommodating at least part of one second contact terminal (7).

fig - 2a



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Description

The present invention relates to a connector, preferably a right angle connector, comprising one or more integrated pcb assemblies, each of said pcb assemblies comprising an insulating substrate, a spacer and a cover plate, each of said insulating substrates comprising a predetermined pattern of conducting tracks on a first surface, each of said conducting tracks having one end for connection to one first contact terminal for mating contact with a mating contact terminal of a mating connector, and another end for connection to one second contact terminal.

Right angle connectors are now widely used and available in many different configurations. For right angle connector structures, the usual method of manufacture consists of stitching terminals into a suitable housing following by tail bending per row. However, the method of bending the tails of each of the terminals is complex, especially since the bending is different for each row. The bending for each row must be done in such a way that each of the board contact terminals substantially extend the same distance from the connector body. Moreover, each of said board contact terminals, in the assembled state of the connector, must be positioned in such a way that the pattern of board contact terminals correspond to the pattern of holes in the pcb into which they will be inserted. An additional difficulty is related to the EMC coupling between the tails for high-frequency applications. In particular for the latter difficulty, a controlled-impedance tail section is preferred with additional ground shielding options. Towards this end, it is known to subdivide the manufacture of such a connector into one part for accommodating contact terminals for mating contact with the contact terminal of a mating connector and a separate part for the tail end. Separate shielding casings, if required in a right angled configuration, may be provided around each of the terminals within the connector. Although connectors manufactured in this way operate satisfactorily the manufacturing costs are still high.

US Patent 4,571,014, from which the claims are delimited, shows an entirely different approach for the manufacturing of right angle connectors. US Patent 4,571,014 describes a right angle connector which is manufactured from one or more integrated pcb assemblies. Each of the pcb assemblies comprises one insulated substrate, one spacer, and one cover plate which are attached to one another. The insulating substrate is provided with a predetermined pattern of conducting tracks, while ground tracks are provided between the conducting tracks. The conducting tracks are connected at one end to a female contact terminal and at the other end to a male contact terminal. Each of the cover plates are conductive shield members.

In the arrangement according to US Patent 4,571,014, the insulating substrates are rather thick to allow plated blind holes to be made for the construction of female-type contacts for mating contact with male-type pins of a mating connector or the like. The female contacts are connected to conducting tracks on the surface of the insulating substrate through a thin metal tail extending from the plated blind hole through the material of the insulating substrate to the corresponding track. However, in practice it is very difficult to produce such constructions with thin metal tails in a cheap and reliable way. Moreover, it is practically very difficult to produce deep plated blind holes having a plating of a substantially equal thickness. Because of the application of plated blind holes within the insulating substrates each of the printed circuit boards have to have a predetermined thickness which reduces the possibilities of miniaturization.

Another disadvantage of the connector known from this US Patent 4,571,014 is that the shield members, the insulating substrates and the spacers have to be aligned with small holes and are fixed to one another by conducting rivets or pins through the aligned holes; the holes in the insulating substrates are plated through-holes, thus establishing an electrical contact between each of the ground tracks between the conducting tracks and the shield members in the assembled state. However, in practice this is not a very reliable way of assuring electrical contact between the shield members and the ground tracks on the insulating substrates.

The object of the present invention is to provide a connector which uses the basic technology proposed in US Patent 4,571,014 but which overcomes the disadvantages described above.

This object is obtained by the present invention by providing a connector according to the preamble of claim 1 and which is characterized in that each of the spacers are provided with a first set of one or more first openings each arranged for accommodating at least part of one first contact terminal and with a second set of one or more second openings each arranged for accommodating at least part of one second contact terminal. By the application of such a first set of one or more first openings and a second set of one or more second openings the respective first contact terminals can be easily connected to the respective conducting tracks. This also applies to female-type contact terminals. No complicated plated blind holes are necessary to make female-type contact terminals since the openings in the spacer provide enough space for accommodating female-type contact terminals.

In order to provide shielding between adjacent conducting tracks, ground tracks may be provided between them upon the first surface, whereas a ground layer may be provided on a second surface opposite the first surface.

In a preferred embodiment, each of the cover plates are made of insulating material and are provided with cover plate conducting tracks and cover plate ground tracks in a predetermined pattern on a first cover plate surface facing said insulating substrate, each of said cover plate conducting tracks having one end for connection to one first contact terminal and another end for

connection to one second contact terminal, each of said cover plates having a second cover plate surface opposite said first cover plate surface and being covered by a cover plate ground layer. Thus, each of the first contact terminals is connected to one second contact terminal through one conducting track on the insulating substrate and through a conducting track on the cover plate. Thereby, the electrical resistance between a first contact terminal and a respective second contact terminal is reduced. The pattern of conducting tracks on the insulating substrate and the pattern of conducting tracks on the cover plate may have a mirrored relation to each other.

In a further preferred embodiment, the ground tracks on the insulating substrate and the cover plate ground tracks on the cover plate, respectively, are connected to the ground layer on the second surface of the insulating substrate and to the cover plate ground layer, respectively, through plate through-holes. This can be easily achieved, by starting the production of a connector according to the invention with an insulating substrate having metal layers at both sides. One side of the substrate is, then, patterned to be provided with suitable conducting tracks and ground tracks in a predetermined pattern, in accordance with known pcb manufacturing techniques. The ground tracks may then be electrically connected to the metal layer at the opposite side by plated through-holes, which can be made by well known manufacturing techniques. This method of establishing electrical contact between each of the ground tracks and a ground layer is much more reliable than the method described in US Patent 4,571,014.

Preferably, each of the first openings are designed for entirely accommodating one first contact terminal in such a way that, in the assembled state, none of the first contact terminals extend outside the connector. When in such a configuration the connector is provided with a shielding ground layer, a better extent of shielding is obtained, since it is possible to enclose each of the contact terminals to a greater extent.

Each of the second contact terminals may be selected from the group comprising press-fit pins, surface mount terminals and solder contact pins for connecting the connector to a printed circuit board or the like.

The connector may also comprise an insulating connector body accommodating each of said one or more integrated pcb assemblies and provided with a metallized shielding layer on its outer surface. Thereby, the electromagnetic interference caused by such a connector to the environment is further reduced.

A simplified configuration results when in the connector according to the invention each spacer and its adjacent cover plate are substituted by another cover plate, provided with suitable recesses for accommodating first contact terminals and/or second contact terminals.

The connector may be provided with suitable filter elements by arranging at least one electrical component within the connector, for instance selected from the group of components comprising resistors, capacitors and inductors.

The present invention will be further illustrated with reference to some drawings which are meant for illustration purposes only and not intended to limit the scope of the present invention. In the drawings:

figure 1 schematically shows a connector in order to illustrate the principles of the present invention;
figures 2a-2c show a right angle connector manufactured in accordance with the invention;
figures 3a through 3c show a right angle connector according to an alternative method in accordance with the present invention.

It is to be understood that although figures 2a-2c and 3a-3c showing right angle connectors the principles of the present invention equally apply to connectors suitable for connection under any other angle.

Figure 1 shows an integrated pcb assembly having an insulating body 13. The insulating body 13 may be provided with shielding ground layers 9 at either main outer surface. However, depending on the application one of the shielding ground layers, or both, may be omitted.

The body 13 is provided with a first series of holes 2 in a first side surface for accommodating suitable contact terminals 4. At a second side surface, the body 13 is provided with similar holes 3 for accommodating suitable board contact terminals 7. Each of said holes 2 and 3 are metallized. They may be entirely or partly metallized.

Each of the contact terminals 4 is shown to have a female-type contact portion 14, a tail connect portion 6 and a body connect portion 5. Each of the body connect portions 5 is designed to be received by one of the metallized holes 2 and to be electrically connected to the metal layer within the hole 2, e.g. by soldering or a press-fit connection.

If desired, each of the female-type contact portions 14 may be substituted by male-type contact portions or hermaphrodite-type contact portions, as is known to any person skilled in the art.

Each of the board contact terminals 7 is shown to have a board contact portion 15 and a body connect portion 8. Each of the body connect portions 8 is to be received by one metallized hole 3 and to be connected e.g. by soldering or by a press-fit connection thereto. Each of the board contact portions 15 is designed to be received by an appropriate hole in a printed circuit board and to be connected thereto e.g. by soldering. However, a press-fit connection can also be provided instead. As a further alternative, the board contact portion 15 may be designed to be suitable for surface mount connection to a printed circuit board. It is observed that the phrase "printed circuit board" is not used in a limiting sense, but is meant to include any kind of substrate to which connectors and right angle con-

nectors may be connected, as is known by a person skilled in the art.

Each of the metallized holes 2 are electrically connected to a corresponding metallized hole 3 by suitable conducting means within the body 13. These suitable conducting means may be conducting tracks 11 as will be explained below by reference to the other figures.

In order to provide a shielding effect between adjacent conducting means 11 within the body 13 ground tracks 10 may be provided inbetween. Instead of providing a ground track 10 between each two adjacent conducting means 11 other configurations are possible. Ground tracks 10 may e.g. be present between adjacent groups of two conducting means 11 thus having a twinax-type configuration.

Figures 2a through 2c show subsequent manufacturing steps of producing a right angle connector according to the invention in which standard methods of producing printed circuit boards are used.

Figure 2a shows an insulating substrate 16 provided with several parallel conducting tracks 11. Conducting ground tracks 10 may be provided between adjacent conducting tracks 11. The outermost conducting ground track 10 is provided with a ground contact terminal 7' to be connected to ground through the printed circuit board to which the connector is to be connected. Methods of producing an insulating substrate 16 with parallel conducting tracks 10, 11 are widely known in the field of manufacturing printed circuit boards and need not be explained here.

Each of the conducting tracks 11 is connected to board contact terminals 7, the board contact portions 15 of which extending beyond the insulating substrate 16. Although the board contact portions 15 are shown as solder contact terminals they might be replaced by suitable press-fit contact terminals or surface mount terminals as mentioned above.

The other ends of the conducting tracks 11 are connected to suitable contact terminals 4 which, in the embodiment shown in figures 2a through 2c, do not extend beyond the insulating substrate 16.

An insulating spacer 17 is provided having a first series of openings 24 for accommodating the contact terminals 4 and a second series of openings 25 for accommodating at least part of the board contact terminals 7.

An insulating cover plate 18, possibly provided with a ground layer 9, is provided.

To reduce the electrical resistance between each of the contact terminals 4 and the board contact terminals 7 each of the insulating cover plates 18 may be provided with suitable conducting tracks 11 one side of which is connected to a contact terminal 4 and the other side of which is connected to a board contact terminal 7. These conducting tracks may be provided in a mirrored relation to the conducting tracks 11 on the insulating substrate 16. Cover plate 18 may also be provided with ground tracks 10 between those conducting tracks 11 (not shown). These ground tracks 10 are preferably connected to the ground layer 9 by means of plated through holes 26. The manufacturing of plated through holes is known to persons skilled in the art and need no further explanation. Of course, substrate 16 may be provided with similar plated through holes 26 in order to connect ground tracks 10 to ground layer 9 at the outer surface of substrate 16.

Figure 2b shows one integrated pcb assembly manufactured from the components shown in figure 2a, i.e. an insulating substrate 16 to which an insulating spacer 17 is attached and an insulating cover plate 18 attached to the insulating spacer 17. Because of the first series of openings 24 in the insulating spacer 17 and the female-type contact terminals 4 suitable holes 2 are provided to receive contact terminals of a mating connector (not shown). It is to be understood that the female-type contact terminals 4 shown in figure 2a may be replaced by male-type or hermaphrodite-type contact terminals.

Instead of providing both a spacer and a cover plate 18, only a cover plate could be provided in which suitable recesses are made for accommodating the contact terminals 4 and the board contact terminals 7. Such recesses would serve the same purpose as openings 24, 25 in spacer 17 shown in figure 2a. Alternatively, such recesses could be provided in substrate 16.

Figure 2c shows several integrated pcb assemblies as shown in figure 2b parallel to each other and to be inserted into a connector body 19. The connector body 19 may be made of any insulating material and may be provided with a metallized outer surface to enhance the shielding effectiveness. The connector body 19 may be provided with suitable guiding ridges 23 and one or more guiding extensions 22 for properly connecting the assembled connector to a mating connector (not shown).

A connecting pin 21 to be fixed to a suitable hole within a printed circuit board to which the connector is to be connected is provided at the bottom side of the connector body 19. Preferably, each of the integrated pcb assemblies have at least one ground layer 9 at one of their main outer surfaces to shield the parallel integrated pcb assemblies from each other. The outer surfaces of each of the outer integrated pcb assemblies in the configuration shown in figure 2c are also preferably provided with ground layers 9 to enhance the shielding effectiveness.

The connector body 19 is provided with suitable lead-in holes 20 in corresponding relationship with each of the contact terminals 4. Each of the lead-in holes 20 is suitable for receiving a mating male-type contact terminal of a mating connector (not shown). The lead-in holes 20 are arranged in columns and rows as is designated by arrows c and r.

The main difference between the embodiments of figures 2a through 2c and figures 3a through 3c is that the contact terminals 4 in the embodiments of figures 3a through 3c are extending beyond the outer dimensions of the integrated pcb assembly.

In figure 3a several contact terminals 4 are shown

adjoined on a carrier as one stamped part. The additional joining metal between adjacent contact terminals 4 is stamped away as a final step during manufacturing. The function of the carrier is to form a one stitch process.

Also board contact terminals 7 are shown to be adjoined on a carrier as one stamped part. The additional joining metal between adjacent board contact terminals is stamped away as final step during manufacturing.

Also here, the cover plate 18 may be provided with a plurality of suitable conducting tracks one side of which is to be connected to one contact terminal 4 and the other side of which is to be connected to one board contact terminal 7 in order to reduce the electrical resistance.

Either of the insulating substrates 16 or the insulating cover plates 18 may be provided with a suitable ground layer 9.

The insulating substrate, the insulating spacer and the insulating cover plate are adhered to each other by widely known means like glue, conductive adhesives in track areas and/or use of pressure in order to produce one integrated pcb assembly as shown in figure 3b.

Like in the embodiment according to figures 2a-2c spacer 17 could be omitted whereas, then, cover plate 18 could be provided with suitable recesses for accommodating those parts of contact terminals 4 and board contact terminals 7 not extending from substrate 16. Alternatively, such recesses could be provided in substrate 16.

Several parallel integrated pcb assemblies as shown in figure 3b are introduced in the rear side of a connector body 19 which is provided with suitable openings in the rear side to accommodate the extending contact terminals 4 (figure 3c). When shielding between adjacent contact terminals 4 is required shielding means will have to be provided within the connector body 19. However, this complicates the manufacturing of the connector according to figures 3a through 3c. In such a case, the connector according to figures 2a through 2c is preferred since in the embodiment according to figures 2a through 2c it is easier to provide for shielding measures between adjacent contact terminals 4.

It is to be understood that the present invention is not limited to the embodiments shown in the figures. Especially, the invention is not limited to providing integrated pcb assemblies having one insulating substrate 16, one spacer 17 and one cover plate 18. Other numbers of substrates, spacers and cover plates are possible without going beyond the scope of the present invention. Moreover, the substrate 16, spacer 17 and cover plate 18 may have any desired dimension. Since separate substrates, spacers, cover plates etc. may be used to manufacture connectors in accordance with the invention filter elements, like resistors, capacitors and inductors, can be easily incorporated within the connector by using well known pcb manufacturing techniques. They may be manufactured by well known thin film techniques.

Any of the insulating substrates 16 may, e.g., be provided with suitable connecting pins to be received by suitable holes in the insulating cover plates 18 to provide easier alignment of parallel integrated pcb assemblies and to prevent shifting of integrated pcb assemblies when inserting several parallel integrated pcb assemblies into the rear side of the connector body 19.

The connector according to the invention can be manufactured by using standard and cheap pcb manufacturing methods without the stamping/moulding/bending processes which are now widely used and which are relatively expensive. Moreover, impedance matching can be easily obtained since the manufacturing tolerances can be easily controlled. The connector according to the present invention can also be designed for mini coax or twinax applications.

Although in the description presented above, the connector according to the invention is provided with a set of contact terminals 4 at one side and a set of board contact terminals 7 at another side it is to be understood that the principles of the invention also apply to connectors in which the board contact terminals 7 are substituted by contact terminals suitable for connection to a mating connector or the like. Moreover, the set of contact terminals 4 may be constructed as board contact terminals to be suited for connection to a printed circuit board or the like.

Claims

1. A connector, preferably a right angle connector, comprising one or more integrated pcb assemblies (1), each of said pcb assemblies comprising an insulating substrate (16), a spacer (17) and a cover plate (18), each of said insulating substrates (16) comprising a predetermined pattern of conducting tracks (11) on a first surface, each of said conducting tracks (11) having one end for connection to one first contact terminal (4) for mating contact with a mating contact terminal of a mating connector, and another end for connection to one second contact terminal (7), characterized in that each of the spacers (17) are provided with a first set of one or more first openings (24) each arranged for accommodating at least part of one first contact terminal (4) and with a second set of one or more second openings (25) each arranged for accommodating at least part of one second contact terminal (7).

2. A connector according to claim 1 wherein ground tracks (10) are provided between adjacent conducting tracks (11) on said first surface of each of said insulating substrates (16) in a predetermined pattern and a ground layer (9) on a second surface opposite the first surface.

3. A connector according to any of the claims 1 or 2 wherein each of said cover plates (18) are made of insulating material and are provided with cover plate conducting tracks (11) and cover plate ground tracks (10) in a predetermined pattern on a first cover plate surface facing said insulating substrate (16), each of said cover plate conducting tracks having one end for connection to one first contact terminal (4) and another end for connection to one second contact terminal (7), each of said cover plates (18) having a second cover plate surface opposite said first cover plate surface and being covered by a cover plate ground layer (9).

4. A connector according to claim 2 or 3 wherein the ground tracks (10) on the insulating substrate (16) and the cover plate ground tracks (10) on the cover plate (18), respectively, are connected to said ground layer (9) on the second surface of the insulating substrate (16) and to the cover plate ground layer (9), respectively, through plated through holes (26).

5. A connector according to any of the preceding claims wherein each of said first openings (24) are designed for entirely accommodating one first contact terminal (4), in such a way that, in the assembled state, none of the first contact terminals (4) extend outside the connector.

6. A connector according to any of the preceding claims wherein each of said second contact terminals (7) is selected from the group comprising press-fit pins, surface mount terminals and solder contact pins for connecting the connector to a printed circuit board or the like.

7. A connector according to any of the preceding claims provided with an insulating connector body (19) accommodating each of said one or more integrated pcb assemblies (1) and provided with a metallized shielding layer on its outer surface.

8. A connector according to claim 1 wherein each spacer (17) and its adjacent cover plate (18) are substituted by another cover plate provided with suitable recesses for accommodating first contact terminals (4) and/or second contact terminals (7).

9. A connector according to any of the preceding claims comprising at least one electrical component within the connector, for instance selected from the group of components comprising resistors, capacitors and inductors.

Fig - 1

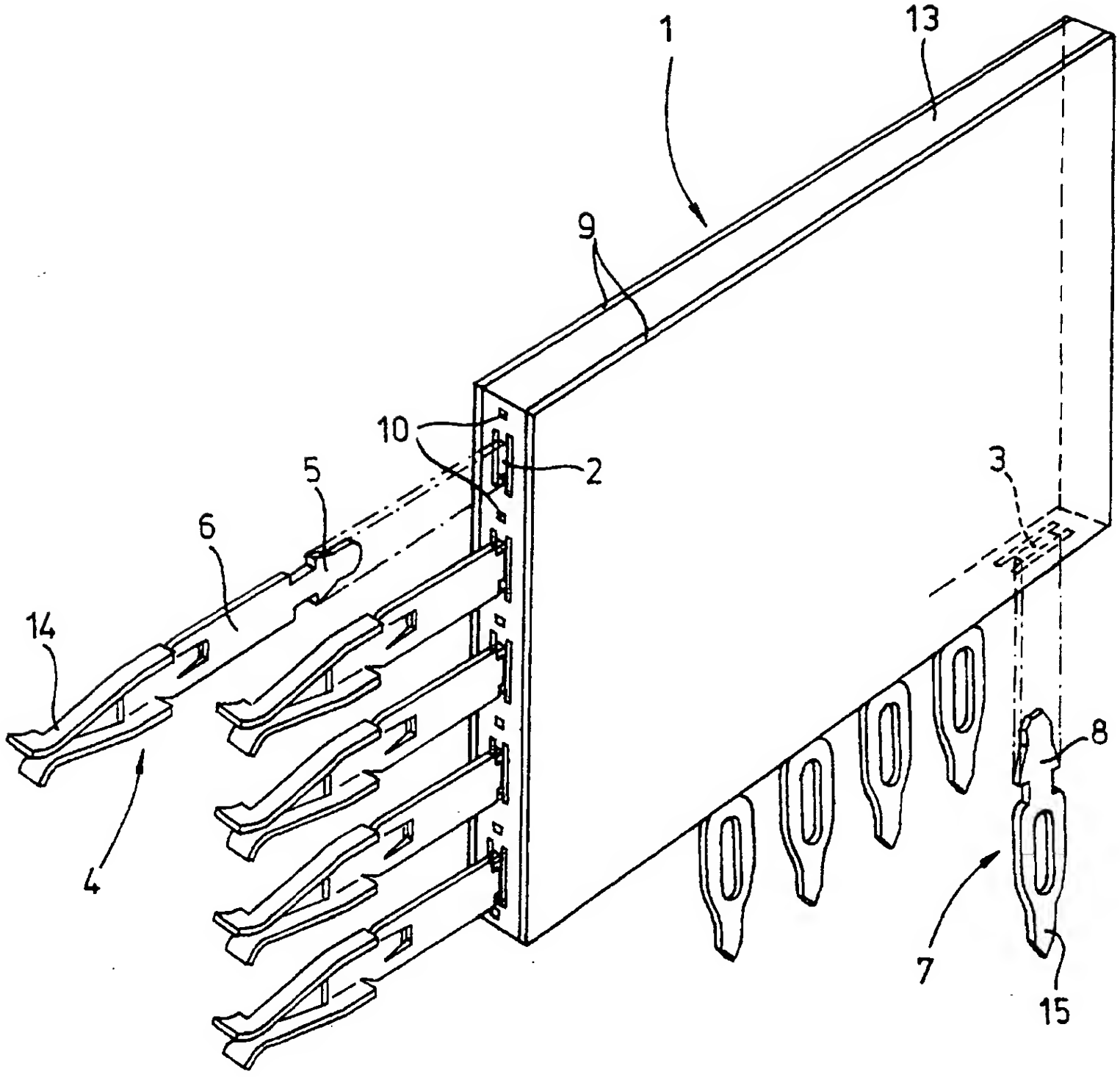


fig-2a

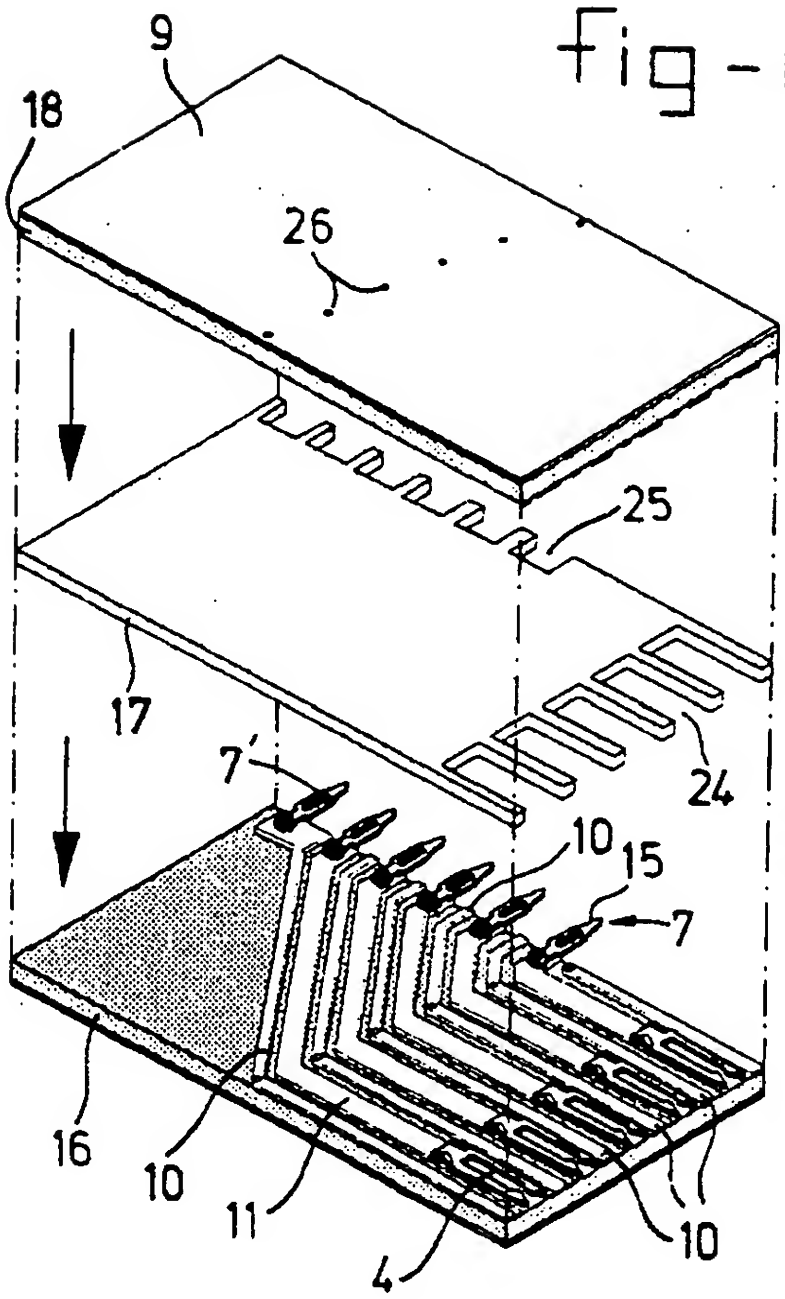


fig-2b

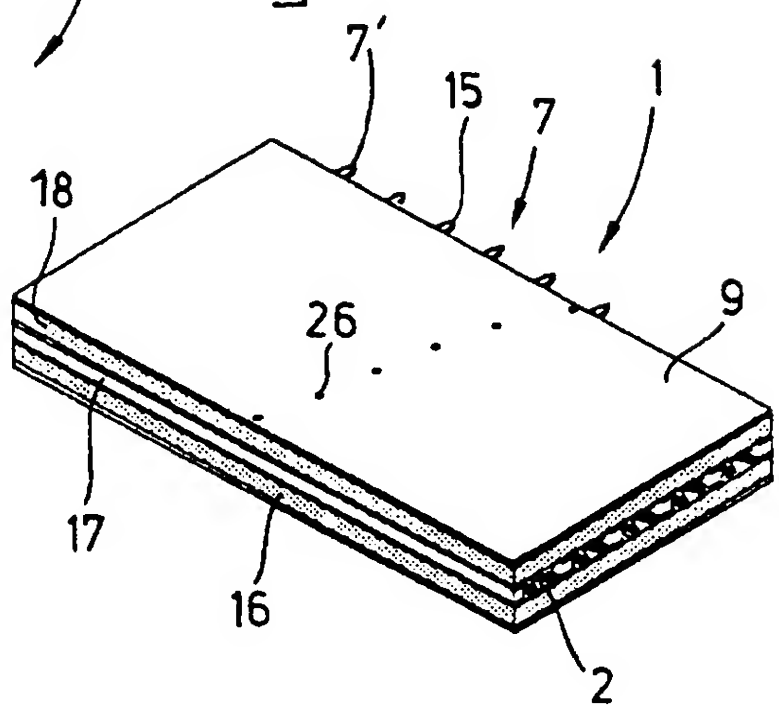
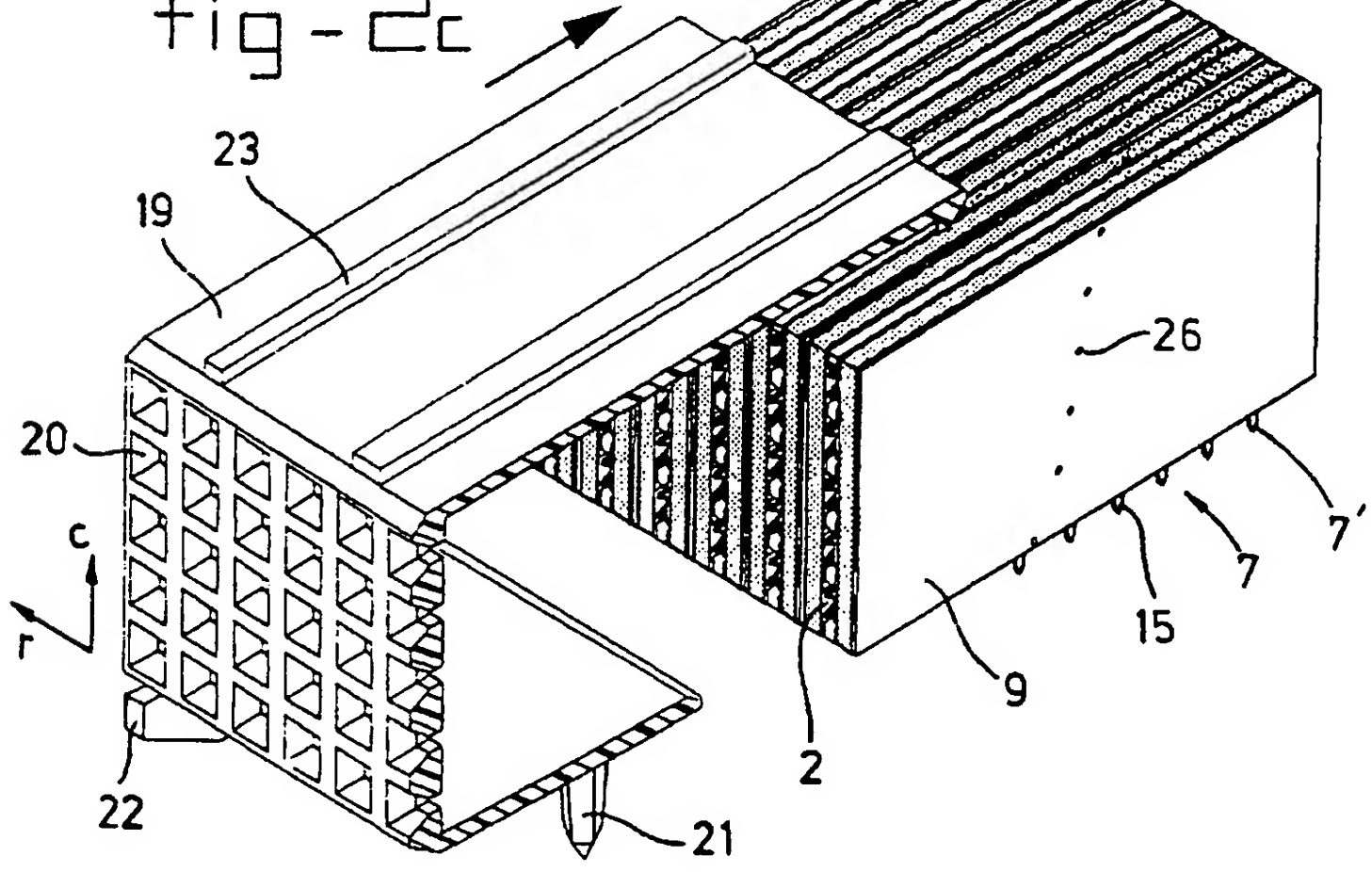


fig-2c



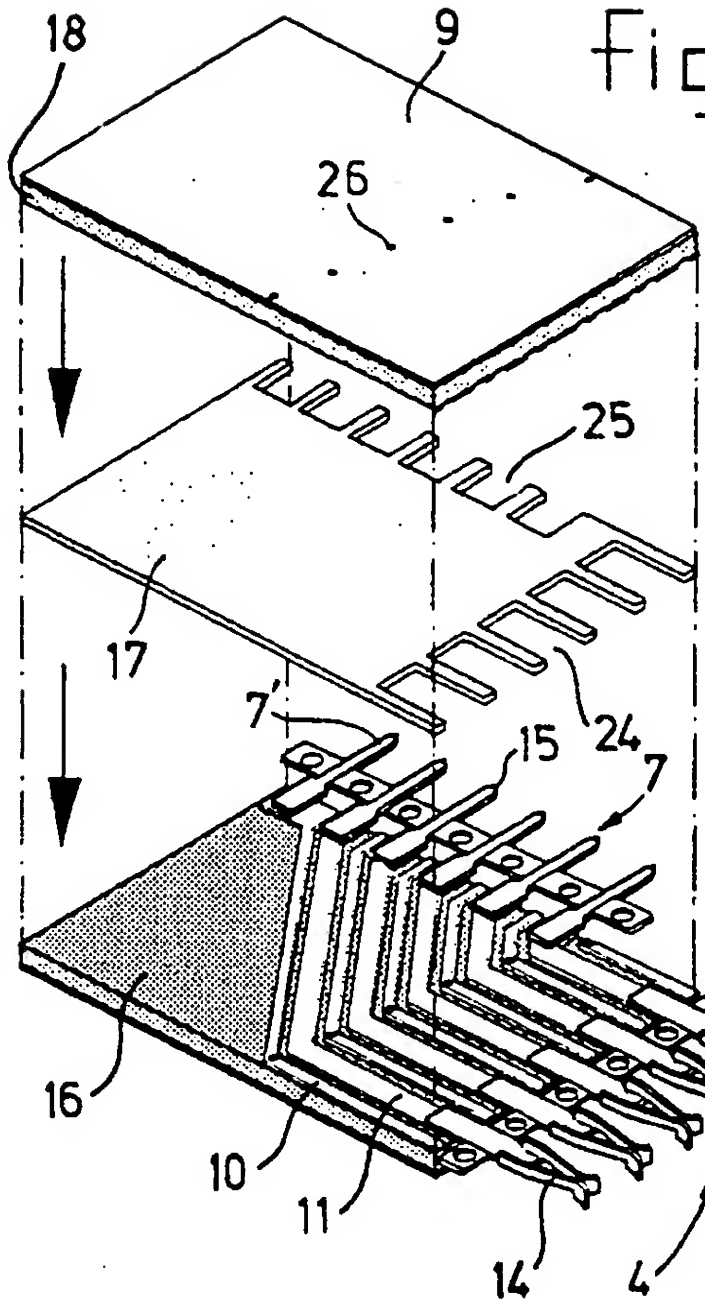


Fig - 3a

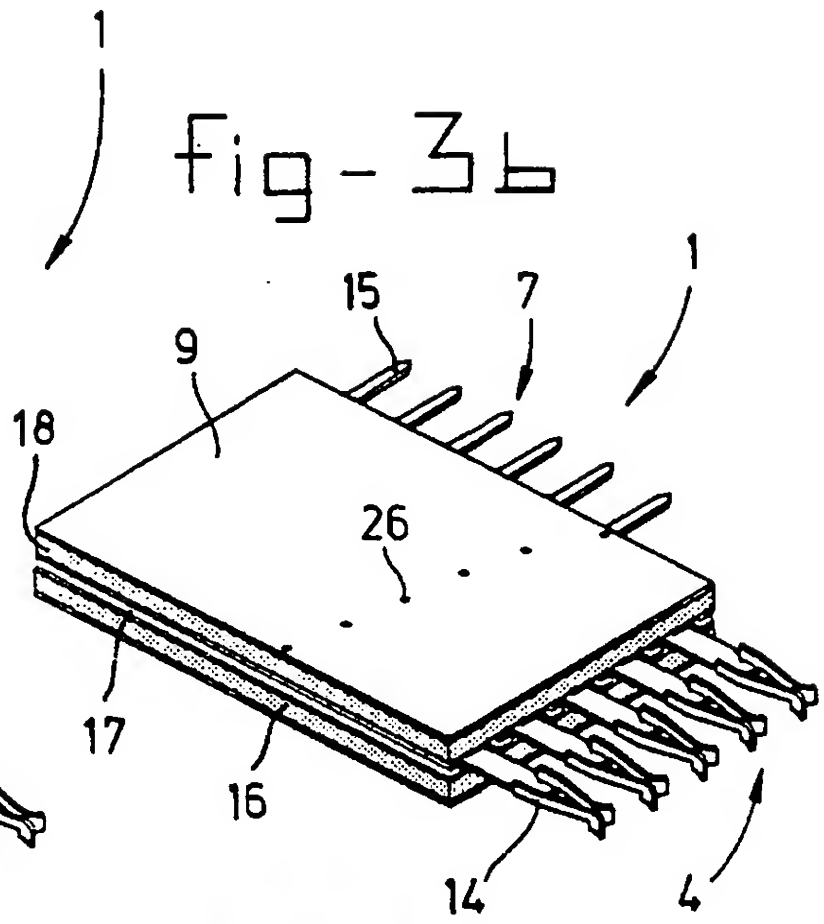


Fig - 3b

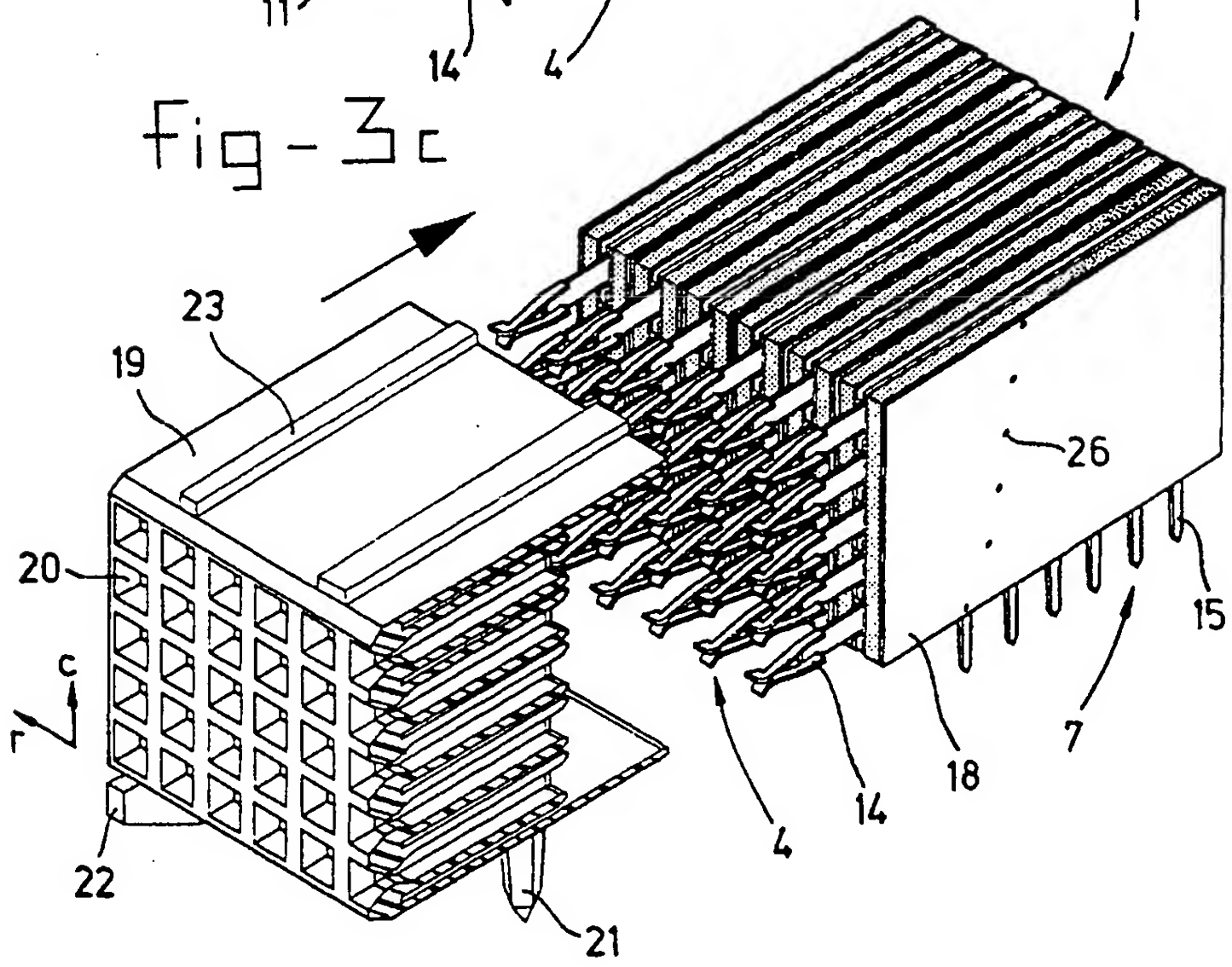


Fig - 3c

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 20 1811

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 018 no. 509 (E-1610) ,26 September 1994 & JP-A-06 177497 (SUMISE DEVICE:KK) 24 June 1994, * abstract *	1	H01R23/68
D,A	US-A-4 571 014 (ROBIN MAX S ET AL) 18 February 1986 * column 4, line 25 - line 60; figures 3,6,7 *	1,2,4,6	
A	EP-A-0 488 482 (DU PONT ;DU PONT NEDERLAND (NL)) 3 June 1992		
A	WO-A-94 06179 (SIEMENS AG ;MAIR EDUARD (DE); MILDE GUNDOLF (DE); SEDLMEIER PETER) 17 March 1994		
A	EP-A-0 486 298 (AMP INC ;NIPPON ELECTRIC CO (JP)) 20 May 1992		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 November 1995	Marti Almeda, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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